Attenuation of Third Sound in Thick Films of Superfluid 4He and 3He/4He Mixtures

Richard E. Packard, U. of California at Berkeley, DMR-0244882

Superfluid flow of 4He in the bulk is inviscid. However, in superfluid films formed on a substrate surface, waves mitigated by the substrate's attraction, or Third Sound, dissipate much stronger than expected. We present two experimental studies of the dissipation, and a theoretical model ascribing the attenuation to the interaction of the flow with the quantum vortices, or eddies, that form on irregularities of the substrate.

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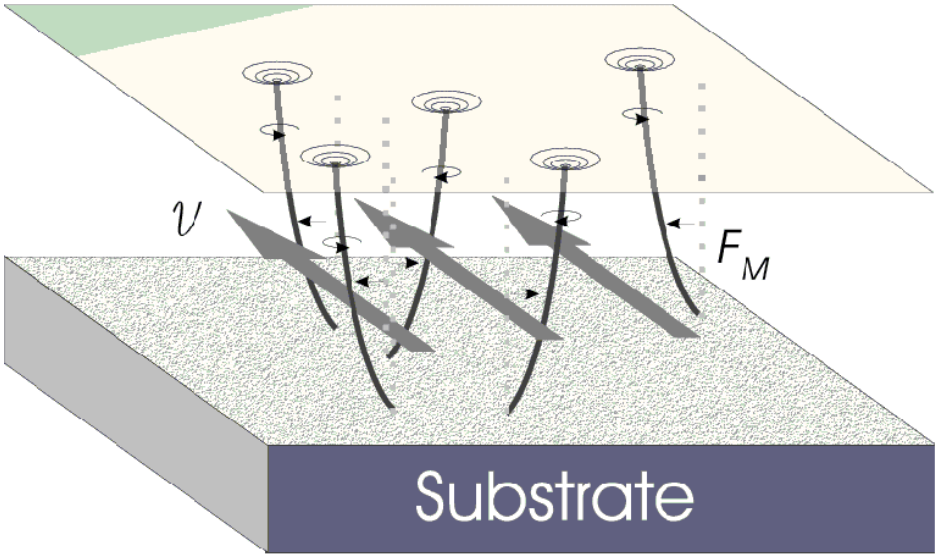

Vortices are pinned at surface irregularities. In the flow field of the third sound wave they are deflected by Magnus force. Interaction between the vortices and the viscous component (normal component and ^{3}He impurities) leads to attenuation.

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Education:

An undergraduate (Benjamin Hodges), a graduate student (Joan Hoffmann), and a postdoc (Konstantin Penanen) contributed to this work. Undergraduate Benjamin Hodges entered graduate program at Scripps Institution of Oceanography at UC San Diego. Joan Hoffmann received an IBM Graduate Fellowship and also was given a summer internship at IBM-Watson. Konstantin Penanen is currently a Caltech postdoc at the Jet Propulsion Laboratory.

Outreach:

The PI, Joan Hoffmann and Konstantin Penanen participated in the Physics Department Open House events. These included the demonstration to middle-school students of how properties of materials (fruit, ice cream, and pennies) change when they are frozen to liquid nitrogen temperatures. Joan Hoffmann gave lab tours and demonstrations to 8th graders from the Julia Morgan School for Girls, and volunteered as a science and math instructor at San Quentin State Prison. Konstantin Penanen conducted the annual Bay Area Undergraduate Physics Competition at UC Berkeley.